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The Impact of Screening Criteria on Entrepreneurship Research

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Entrepreneurship researchers use various types of screening criteria to select samples for study. In that selecting these criteria is, in effect, choosing a definition or model of entrepreneurship, the consequences are immense and have had a direct impact on the generalizability of research and theory development in our field. The purpose of this study is to help entrepreneurship researchers better understand these consequences and, thereby, improve our understanding of entrepreneurial phenomenon. Four of the most commonly used screening criteria are included in this study: firm age, firm size, firm growth, and innovation. Based on a sample of 368 manufacturing firms, the results indicate that few firms fit all or even most of the considered screening criteria and independent-dependent variable relationships vary considerably by screening criteria selection.

Entrepreneurship is an important phenomenon in the U.S. and world economies. As a result, it has also become of great importance in academic research. Many articles on the subject begin by citing impressive statistics about job creation, innovation, and general economic development as a result of entrepreneurial efforts. Despite the importance of entrepreneurship and the growing volume of research in entrepreneurship, there are still important issues to be addressed that could significantly affect the young, developing field (Ireland, Reutzel, and Webb 2005; Kickul, Krueger, and Maxfield 2005). Moreover, research on many of the important issues has yielded mixed results. An oft-cited cause for such results is the variance in research methodology from study to study (Cooper and Dunkelberg 1987; Vanderwerf and Brush 1989). One of the more fundamental differences between studies is sample selection. At issue is whether our research results vary depending on the screening criteria we employ to select a sample of firms that are "entrepreneurial." For example, do studies looking at the effects of planning on profitability have varying results depending on whether the samples studied were of small, new, high-growth, or innovative firms? The question is an important one for the field. Mixed research results make it difficult to develop sound theory and provide meaningful insights to practicing entrepreneurs. Moreover, the ability to generalize from our findings is greatly inhibited.

To address this question, a study of 368 manufacturing firms was conducted. As anticipated, the relationships between dependent and independent variables did vary depending on the criteria used in sample selection. The following sections begin with a general discussion of the literature on the potential impacts of research methodology on the results of entrepreneurship research. Next, we provide a discussion of the literature on the various screening criteria used in entrepreneurship research and an in-depth look at a few of the most popular approaches. Finally, we discuss the results, findings, and implications of this study.

Potential Impacts on Research Methodology

In the late 1980s, a number of prominent scholars called attention to basic problems with research methods being used in entrepreneurship research (see for example, Bygrave 1989; Cooper and Dunkelberg 1987; Vanderwerf and Brush 1989). Specifically, Vanderwerf and Brush (1989) pointed out that authors were not carefully specifying and communicating the screening criteria used to select their samples of entrepreneurs or entrepreneurial firms. Clearly, considerable improvement has been made in entrepreneurship research since that observation (Chandler and Lyon 2001). However, research methods remain an important issue for the advancement of the still young field. Note, for example the Fall 2005 special issue of the *New England Journal of Entrepreneurship* was devoted to measurement issues in entrepreneurship studies.

Vanderwerf and Brush (1989: 46–48) reviewed the development of five fields of science (magnetism, physical chemistry, X-ray crystallography, radio astronomy, and physical biology) and concluded that each field initially was characterized by "disagreements and shifts in opinion on precisely what entities or phenomenon should be included." Despite these disagreements, research in each of the fields converged on "one or a few distinct populations." Following this convergence, each field experienced more rapid development, perhaps, according to Vanderwerf and Brush (1989), because there was "more synergy among the separate studies performed by different investigators." Interestingly, after each discipline experienced rapid development as a result of narrowing their focus, each discipline then expanded the range of populations considered.

Vanderwerf and Brush (1989) and Ireland, Reutzel, and Webb (2005) all agree that entrepreneurship as a field is still in its early stages of development. To accelerate development in the field of entrepreneurship, Vanderwerf and Brush (1989) suggested that rather than imposing a definition of entrepreneurship on the field with its associated screening

variable(s), authors should carefully specify their samples. Vanderwerf and Brush (1989: 52) pointed out that careful specification would "facilitate decisions by researchers about populations they want to study by making the alternatives more precise and explicit" and "facilitate the later use of the data generated."

Although entrepreneurship researchers are now more likely to communicate the screening variables used to arrive at their sample of entrepreneurial firms, the empirical literature has not adequately considered the effects of using different screening criteria. Common screening criteria variables have been studied as moderators, effectively capturing information on resulting differences within a screening criterion (examples include: small vs. large firms, new vs. established firms). Randolph, Sapienza, and Watson (1991) noted different results for small young firms and small high-growth firms in the link between technology-structure fit and firm performance. However, the majority of the literature has paid little attention to differences between screening variables (size vs. age versus growth vs. innovation). As Vanderwerf and Brush (1989) noted, this issue is important in facilitating cross-study comparisons and accelerating the rate of progress in the field. The dilemma for the field of entrepreneurship regarding the issue of screening criteria is in understanding when and how the use of different screening criteria are consistent and when they are not.

When entrepreneurship researchers use different screening criteria to define, identify, and select desired samples, a potential source of inconsistency is introduced, but only to the extent that differences in screening criteria lead to different samples that produce different results. From a practical theory building perspective, the use of different screening criteria presents a serious cause for caution when they result in different samples that produce differential effects on research outcomes. The logic supporting this assertion is identical to that underlying past research investigating the effects of sample source selection. The use of different sources to identify samples for entrepreneurship research (such as Dun & Bradstreet, telephone directories, chambers of commerce, state ES 202 and sales tax files, directories of manufacturing and wholesaling, etc.) has created the potential for inconsistencies in the literature. Empirically, different sources such as those listed above have been shown to lead to samples that do not cleanly overlap and are systematically different on important characteristic variables (Aldrich et al. 1989; Birley 1986; Busenitz and Murphy 1996; Kalleberg et al. 1990). Murphy (2002) extended this line of research to show that the use of different sample sources could result in different independent-dependent variable relationships. Although the effects of using different sample sources on entrepreneurship research outcomes have been explored, the effects of using different screening criteria on entrepreneurship research outcomes have largely been ignored. This article investigates this issue by examining four common and important screening criteria to entrepreneurship research: firm age, firm size, firm growth, and innovation.

Using Screening Criteria in Entrepreneurship Research

Entrepreneurship researchers employ screening criteria to select samples that match the specific focus on the given research project. For example, screening on firm age is logically employed when the research focuses on start-up or early firm development activities. Screening criteria are also employed when the focus of the research does not correlate to the selection of an obvious screening criterion. For example, research on gender differences between male and female owners of "entrepreneurial" ventures could use any number of screening criteria to arrive at a sample of interest: firm size, firm age, founder status, etc. Likewise, research on entrepreneurial orientation and family business could employ a variety of different criteria to arrive at a sample of interest. To demonstrate this point, Ensley and Pearson's (2005) study of family firms screened on new ventures (firm age) while Chrisman, Chua, and Litz's (2004) study of family firms screened on small firms (firm size).

A wide variety of screening criteria are used in the entrepreneurship literature (Vanderwerf and Brush 1989; Murphy 1996). Some screening criteria focus on the firm (examples include firm age and firm size) while others focus on the person (such as founder or owner/operator). While examining the effects of selecting samples based on the person is important, in the interest of parsimony, the focus of this article is on commonly used firm level screening variables. In particular, four firm level screening criteria variables are considered: firm age, firm size, firm growth, and innovation. While innovation can also be considered a personal variable, a considerable amount of research has focused on innovation at the firm level.

Vanderwerf and Brush (1989) and Murphy (1996) examined the frequency of use of firm level screening criteria and concluded that firm age and firm size were the most commonly used screening measures. The existing research also suggests that firm growth and innovation are common and important screening criteria. To update the likely use of firm age, firm size, firm growth, and innovation as screening criteria in the published literature, a search of Business Source Premier was conducted on corresponding keywords. The search considered papers published in any of the following journals: *Entrepreneurship, Theory and Practice; Journal of Business Venturing; Journal of Small Business Management; Small Business Economics; Journal of Developmental Entrepreneurship; Academy of Management Journal;* or *Strategic Management Journal.*

The results of the search, conducted in April 2006 are presented in Table 1. "New business" and "new firm" were used as search phrases for firm age. "Small business" was used as a search phrase for firm size, except for papers in the *Journal of Small Business Management* and *Small Business Economics* which used "small firm," "small venture," or "small enterprise" (since small business was in the journal title). "Firm growth" and "business growth" were used as keywords for firm growth. "Venture capital" and "IPO" were then searched for, since it is typically assumed that venture capital backed firms and firms that undergo IPOs are growth oriented (Florin, Lubatkin, and Schulze 2003). Finally, "innovation" was used as a keyword. Interestingly, innovation appears to have more of a focus in the mainstream strategy and management literatures than it does in dedicated entrepreneurship journals. Specifically, many of these papers focus on Austrian economics as their basis for innovation and subsequently for entrepreneurship.

Firm Age

Firm age is the most commonly used screening criteria in entrepreneurship research. Of the 52 papers published in the 1987 and 1988 Frontiers of Entrepreneurship Research, 11 defined their sample as entrepreneurial based on the fact that they had been recently created (Vanderwerf and Brush 1989). Murphy (1996) reviewed empirical articles on entrepreneurial performance published between 1987 and 1996 in the *Journal of Business Venturing; Entrepreneurship, Theory and Practice; Journal of Small Business Management; Academy of Management Journal; Administrative Science Quarterly;* and *Strategic Management Journal.* Of the 99 articles reviewed, 38 used firm age as a screening criterion. Table 1 also confirms that firm age remains a focal point in entrepreneurship research.

In general, most authors explicitly or implicitly suggest that young firms are more entrepreneurial than older firms. Screening samples on age is likely to be done when researchers are investigating new firm founding. Also, as previously mentioned, firm age is likely to be used as a screening criterion when the focal topic does not logically fit the choice of another screening criterion. Recent examples of researchers focusing on firm age as a screening criterion are numerous and include, for example, studies of signaling and legitimacy (Busenitz, Fiet, and Moesel 2005; Delmar and Shane 2004; Reuber and Fischer 2005) and studies of management teams (Amason, Shrader, and Tompson 2006; Chandler, Honig, and Wiklund 2005; Ensley and Pearson 2005).

Firm Size

Firm size has been frequently used as a screening criterion in entrepreneurship research (Murphy 1996; Vanderwerf and Brush 1989). In the 99 studies examined by Murphy (1996), size was used as a screening criterion 32 times. As Table 1 shows, firm size is still a central focus in the entrepreneurship literature. In fact, multiple journals carry the words "small business" in their title (examples include *Journal of Small Business Management, Small Business Economics, Journal of Small Business Strategy,* and *International Small Business Journal*). Examples of recent research using firm size as a screening criterion are also numerous and include, for example, studies of small family firms (Chrisman, Chua, and Litz 2004) and competitive strategies of small firms (Brouthers and Nakos 2004; Ebben and Johnson 2005).

Many researchers and policy makers view small businesses as being clearly distinct from larger firms. The Small Business Administration, for example, uses size standards to determine eligibility for assistance. Some researchers consider small business management to be a distinct field from "entrepreneurship" (often those who view entrepreneurship as the domain of growth- oriented enterprises); others, however, consider small businesses to be a critical part of the domain of entrepreneurship. Small business, for example, is explicitly included in the domain statement of the Entrepreneurship Division of the Academy of Management. Randolph, Sapienza, and Watson (1991) noted that small businesses may have more in common than distinct from other "entrepreneurial" firms since small firms, young firm, and high-growth firms are all associated with early stages of the life-cycle. Small firms are also assumed to be more flexible and risk-taking than larger firms and should as a result, be more innovative (Chen and Hambrick 1995; Randolph, Sapienza, and Watson 1991).

Firm Growth

Much of the entrepreneurship literature focuses on growth as a critical criterion. The Winter, 1997 issue of *Entrepreneurship, Theory and Practice,* for example, was devoted to the related issues of time and growth in entrepreneurial firms. A number of authors have focused their attention on special challenges faced by rapid-growth firms (Barringer, Jones, and Lewis 1998; Fischer et al. 1997; Sexton et al. 1997; Slevin and Covin 1997).

Although growth is frequently used as a performance measure in entrepreneurship research, it is also often used as a screening criterion. Recent examples of researchers focusing on growth as a screening criterion include work on managerial capacity (Barringer and Jones 2004) and absorptive capacity (Jianwen, Welsch, and Stoica 2003). While high-growth ventures are often the direct focus of a research paper (see for example, Florin, Lubatkin, and Schulze 2003), high-growth samples are often drawn indirectly as a result of focusing on highly correlated phenomenon. Researchers focusing on venture capital influence, for instance, tend to logically focus on high-growth companies. Likewise, research

Table 1. Search Results in Business Source Premier for Screening Criteria (April 3, 2006)

	Firm Age (New Bus.)	*Firm Size (Small Bus.)*	*Firm Growth IPO or VC*		*Innovation*
Entrepreneurship, Theory and Practice	126	95	10	52	47
Journal of Business Venturing	108	52	11	108	36
Journal of Small Business Management	57	174*	20	43	48
Small Business Economics	48	86*	7	13	67
Journal of Developmental Entrepreneurship	12	48	1	0	5
Academy of Management Journal	15	10	5	8	90
Strategic Management Journal	36	18	9	17	142

*Searched for "small firm," "small venture," and "small enterprise."

Table 2. Descriptive Statistics of the Subsamples and Correlations

	Mean	*S.D.*	*Youngest*	*Smallest*	*Fastest Growth*
Youngest					
Firm Age	6.6	3.2			
Smallest			**.17		
FTE Employees	4.0	2.7			
Annual Sales	$345,991	$337,953			
Total Assets	$172,454	$239,427			
Fastest Growth			**.16	**-.27	
% Change in Sales	89.5%	117.5%			
Absolute Change in Sales	$1,149,554	$1,416,438			
% Change in Employees	89.6%	151.8%			
Absolute Change in Employees	10.3	14.6			
Most Innovative			.06	.01	*.11
Offers New Products	4.4	.6			
Offers Different Products	4.5	.6			
Superior Technology	.7	.8			
Opportunity Recognition Skills	12.9	2.3			

* = p<.05, ** = p<.01

on the initial public offering process logically focuses on high-growth firms (e.g., Florin, Lubatkin, and Schulze 2003; Welbourne and Cyr 1999).

Innovation

Innovation is still considered by many to be the essence of entrepreneurship. As stated by Drucker (1998) "innovation is the specific function of entrepreneurship, whether in an existing business, a public service institution, or a new venture started by a lone individual in the family kitchen." Drucker (1998: 150) goes on to state that the term entrepreneurship "refers not to an enterprise's size or age but to a certain kind of activity."

Innovative samples are often arrived at indirectly by screening on industries that are believed to be innovative (Ireland, Reutzel, and Webb 2005; Vanderwerf and Brush 1989). Vanderwerf and Brush (1989) and Murphy (1996) noted that industry is often used as a screening variable. Zahra, Ireland, and Hitt (2000) noted the importance of studying high-technology firms given their impact on innovativeness. Lawless and

Anderson (1996) noted the microcomputer industry's impact on innovation. Other examples of research in the entrepreneurship literature focusing on high-tech industries include Shrader (2001) and Atuahene-Gima and Li (2004).

Sample, Methodology, and Results

Data used in this study were part of a larger study on firm level performance. Data were gathered from a sample of Harris County, Texas, new and/or small manufacturing businesses listed in the Dun & Bradstreet Regional Directory-Houston, the Directory of Texas Manufacturers, or the State of Texas Sales Tax Files. To reduce interindustry effects, manufacturing firms in SIC codes 27 (printing and allied industries), 28 (chemicals and allied products), 30 (rubber and plastic manufactured products), 34 (metal fabricating), 35 (machinery manufacturing), 36 (electrical and electronic products manufacturing), and 38 (measuring, analyzing, and controlling instruments) were selected for the study. The sampled firms (1) were privately and independently owned, and (2) were less than five years old, or had fewer than 500 employees. The results of this study should not, therefore, be generalized to corporate ventures. Additionally, since growth rates and measures of innovation were not available in each of the sample sources, appropriate variances in growth rates and innovation for this study are dependent on the respondent firms. Table 2 shows that the subsample of high-growth firms did in fact experience high growth (average of more than 87% two-year growth in sales) and that the innovation subsample did report high values for the markers of innovation.

The basics of the Dillman (1978) approach to survey design and mail-out procedure were followed. Two full mail-outs and a postcard reminder mail-out were used. Of the 1,696 firms eligible to respond, usable responses were returned by 368 of the businesses, yielding a 21.7 percent response rate.

Tests for response bias on multiple characteristic variables revealed that respondents' firms were slightly smaller than nonrespondents'. Respondents identified by the Sales Tax Files also indicated that their firms were older than data reported by the Sales Tax Files. The difference is likely due to measurement issues. Date of first sale was used to establish the age of the business in the survey, while the Sales Tax Files provide data on the date of sales tax number issue. Busenitz and Murphy (1996) found that the Sales Tax Files reported the age of the business accurately 71.7 percent of the time. The remaining 28.3 percent may be capable of significantly biasing the reported age of the business. Also, Busenitz and Murphy (1996) considered a recently purchased business as being new, while this study considered the date of the original sale independent of changes in ownership. As businesses are typically issued a new sales tax numbers when a change in ownership occurs, the likelihood of a large difference between the date of sales tax number issue and the date the business had its first sale increases.

Screening Criteria Variables

Four different screening criteria are tested in this study: firm age, firm size, firm growth, and innovation. To measure firm age, respondents were asked to identify the month and year that the business had its first sale. The log of the length in time from the reported first sale to the month the data was gathered for this study is the measure of age used in this study.

Three markers of firm size were used in this study: number of full time equivalent employees (log), annual sales volume (square root), and total assets (log). Factor analysis, using Varimax rotation, revealed one common factor that explained more than 83 percent of the variance in the three markers of size and had an eigenvalue of 2.5. The individual factor loadings were .92 for annual sales, .92 for total assets, and .90 for number of employees. The resulting factor is used throughout the remainder of the study as the size criterion variable.

Four markers of growth were used in this study: two-year percentage change in sales (square root), two-year absolute change in sales (square root), two-year percentage change in employees (log), and two-year absolute change in employees (square root). Factor analysis, using Varimax rotation, revealed one factor that explained more than 59 percent of the variance in the four measures and had an eigenvalue of 2.36. The individual factor loadings were .83 for percentage growth in employees, .79 for absolute growth in employees, .79 for percentage growth in sales, and .65 for absolute growth in sales. The resulting factor is used throughout the remainder of the study as the growth criterion variable.

Four markers of innovation were used in this study: the extent that the firm offers new products, the extent that the firm offers different or specialty products, the importance of superior technology to the business, and the owner's self-reported opportunity recognition skills. Respondents were asked to indicate, on a five-point Likert-type scale, the extent that their business, compared to its competitors, offers new products. The extent to which a business offers different or specialty products was measured in a like manner. The importance of superior technology was measured by asking respondents to identify and rank the three most important resources of their business from a list of 11 items (superior technology was one of the 11). If the respondent indicated that superior technology was the most important resource of the business, superior technology was coded with a three. If the respondent indicated that superior technology was the second most important resource of the business, superior technology was coded with a two. And if it was identified as the third most important resource, it was coded with a one. To measure the owner's opportunity recognition skills, items

from Chandler and Jansen's (1992) self-reported competency scale were used. In particular, three items were used that asked respondents to rate their ability on a five-point Likert type scale to "identify products people want," to "detect unmet consumer needs," and to "identify products that provide real benefits to consumers." The reliability of the scale was found to be .78. The three responses were then summed to form an overall opportunity recognition score. Factor analysis, using Varimax rotation, revealed a single factor with an eigenvalue of 1.83 that explained more than 45 percent of the variance in the four innovation markers. Individual factor loadings were .85 for offers new products, .78 for offers different products, .52 for opportunity recognition competency, and .49 for technology as a primary resource. The resulting factor is used throughout the remainder of the study as the innovation criterion variable. Table 3 shows the correlations between the screening criteria variables for the full sample.

Subsample Analysis

Subsamples of each screening criterion were taken by selecting the 150 observations that most closely fit the typical definition of entrepreneurship. The formed subsamples were

1. age—the youngest 150 firms,
2. size—the 150 smallest firms,
3. growth—the 150 firms with the greatest two-year historical growth in sales and employees, and
4. innovation—the 150 most innovative firms.

Selecting 150 firms ensured that each subsample was above average on the respective criterion variable and allowed for a sufficient number of observations for later analysis. In each case, the formed subsample was significantly different on the criterion variable than firms not in the subsample. For example, the age subsample was 6.6 years old on average, while the firms not in the subsample were more than 25 years old on average. Table 2 provides additional descriptive information on the subsamples as well as correlations between the subsamples.

Frequency cross-tabulations were then run to assess the overlap between the subsamples. A perfect overlap would indicate complete concordance of criteria and would indicate no further need to investigate differences between criteria. Frequency cross-tabulations of the four subsamples revealed that 120 of the 368 firms in the total sample were identified by one subsample only. A total of 117 firms were identified in exactly two of the subsamples while 67 firms were identified in exactly three of the subsamples. Finally, only 13 firms were found in all four subsamples. Fifty-one of the firms were not included in any of the formed subsamples. The pattern of criteria fit is widely dispersed, indicating that further investigation is warranted. The analysis so far has shown that some, but not all, common screening criteria variables are related. The analysis has also shown that the overlap between subsamples arrived at by screening is spotty at best, indicating that screening criteria selection strongly affects the probability of any given firm being included in the studied sample.

Table 3. Correlations Among Screening Criteria (N=368)

Variable	*1*	*2*	*3*
1. Firm Age (log)			
2. Firm Size (factor)	***.25		
3. Growth (factor)	**-.16	***.35	
4. Innovation (factor)	-.02	.03	.08

* = p<.05, ** = p<.01, *** = p<.001

Effects of Screening Criteria Selection on Independent-Dependent Variable Relationships

The process of screening possible sample entries to arrive at a sample that, according to the authors, is entrepreneurial, introduces the possibility that independent-dependent variable relationships may vary depending on the screening criterion applied. The previous analyses conducted in this study suggest that such effects are possible if not probable. To test this possibility, Chow tests were used to assess the extent that independent variables affect a range of dependent variables differentially depending on the selected screening criterion. A similar methodology was employed by Randolph, Sapienza, and Watson (1991). The formula for the Chow test is:

$$F = [SSEp-(SSE_1+SSE_2+SSE_3)]/k/(SSE_1+SSE_2+SSE_3)/(n_1+n_2+n_3-2k-2)$$

where:

$SSEp$ = sum of squared errors for pooled sample,

SSE_i = sum of squared errors for subsample,

n_i = size of subsample, and

k = number of independent variables.

Evidence of differential independent-dependent variable effects will be indicated if the error sum of squares is significantly reduced by considering the subsamples separately. Significant Chow tests indicate that the subsamples do not result in equivalent regressions. To accomplish these tests, a set of dependent and independent variables were selected for analysis. These variables are not the primary focus of this article but are used as a basis for studying the effects of screening criteria selection on independent-dependent variable relationships.

Thirteen performance measures were chosen as dependent variables. Using multiple dependent variables allows for

multiple Chow tests, reducing the likelihood of misleading findings. Murphy, Trailer, and Hill (1996) identified, among other performance factors, profitability, efficiency, leverage, and liquidity as being commonly used in entrepreneurship research. Accordingly, measures selected for this study were debt to assets, debt to equity, liquidity (current ratio), sales to assets, sales to employee, return on equity, return on assets, return on sales, net income, owner's compensation from the business, profit satisfaction, growth satisfaction, and productivity satisfaction. Data for debt to assets, debt to equity, liquidity, sales to assets, sales to employee, return on equity, return on assets and return on sales were gathered by asking respondents to provide the base information needed for the authors to construct the variables. Respondent's indicated their annual compensation from the business in one of eight categories ranging from less than $10,000 to more than $1 million. The three performance satisfaction measures were gathered by asking respondents to indicate their level of satisfaction with each aspect of performance on a five-point Likert scale.

Sandberg and Hofer (1987) identified external environmental, firm level, and individual level variables as being relevant in determining venture performance. To arrive at a parsimonious set of independent variables, stepwise regression was used to identify variables at the external environmental, firm, and individual levels that affected the chosen dependent variables. Only variables that were significantly related to more than two of the dependent variables were retained for further analysis. Parsimony is necessary in this case since subsequent analyses will have smaller sample sizes.

Industry growth in sales rate, industry concentration ratio, industry-wide advertising, two technology change variables (constructive and destructive), and two industry price competition variables (frequency and intensity of price wars) were considered. Frequency of price wars and intensity of price wars were combined into one factor since they were found to be highly correlated (r=-.91). The single factor explained more than 95 percent of the variance in the two variables and the factor loadings for the variables were -.98 for price war frequency and .98 for price war intensity. Only the price wars factor affected more than two dependent variables and was retained.

For firm level variables, four strategy variables, 10 planning variables and firm advertising were considered. The four strategy variables were reduced to two factors, using Varimax rotation that together explained more than 88 percent of the variance in the four variables. Focus on customer service (.89), product quality (.86), and customer loyalty (.78) loaded on one factor (labeled differentiation) while focus on low price (.99) loaded singly on the other (labeled low cost). The 10 planning variables were reduced to three factors, using Varimax rotation, which explained more than 51 percent of the variance in the 10 variables. Currently having a written business plan (.74), using the plan to complete mergers, acquisitions and alliances (.61), assess feasibility (.56), motivate managers and employees (.56), and to negotiate with suppliers and/or customers (.55) all loaded on the first factor labeled current plan application. Having a written plan when the business was started (.69), using the plan to obtain invest-

Table 4. Illustrative Regression Results: Regression of Independent Variables on Debt-to-Assets by Subsample (Growth, Innovation, and Growth and Innovation)

Independent Variable	*Pooled Sample*	*Subsamples*		
		Growth	*Innovation*	*Growth and Innovation*
Industry Price Wars	-.10	**-.29	-.12	.17
Differentiation Strategy	.04	.10	-.02	-.07
Low-Cost Strategy	.05	**.26	.01	-.15
Initial Planning	***.29	***.38	.16	**-.36
Commitment	-.05	.14	-.06	*-.24
F	***5.19	1.52	.62	**3.30
R Square	.10	.36	.04	.20
Sum of Squares Residual	19.58	3.87	9.71	4.39
N	233	76	83	74

Standardized Regression Coefficients Reported
* = p<.05, ** = p<.01, *** = p<.001

ment (.67) and bank financing (.52), and hours spent developing the initial plan (.67) all loaded on the second factor labeled initial planning. Finally, current average hours planning in a week (.81) loaded separately on the third factor labeled current planning effort. Differentiation, low cost, and initial planning all affected more than two of the performance variables and were retained.

Commitment, based on the Organizational Commitment Questionnaire (Porter and Smith 1970), and education level were considered as individual level variables. Only commitment affected more than two of the performance measures and was retained. The coefficient alpha for the commitment scale was found to be .75.

The five independent variables, industry price wars, differentiation strategy, low-cost strategy, initial planning, and commitment were then regressed on each dependent variable by every combination of two screening criteria. Table 4, for example, shows the regression of the independent variables on debt-to-assets for the pooled sample of firms that were either among the 150 highest growth firms and/or among the 150 most innovative firms. Separate regressions were then run for firms that were in the growth subsample that were not in the innovation subsample, for firms that were in the innovation subsample that were not in the growth subsample, and finally for those firms that were in both the growth and innovation subsamples.

The illustrative results presented in Table 4 show that significant relationships may be present in only one of the subsamples. Industry price wars and low-cost strategy only had statistically significant effects in the growth only subsample while commitment only had a significant effect on the growth and innovation subsample. No significant relationships were found in the innovation only subsample. The illustrative results also show that the pooling of samples may hide significant relationships. A researcher, for example, looking only at the pooled sample would, in this case, conclude that the data does not indicate any significant relationships between industry price wars and debt-to-assets and between low-cost strategy and debt-to-assets, even though strong relationships can be found in the growth only sample. Table 4 also shows, in this illustrative example, that the pooled sample regression has greater error variance (19.58) than the sum of the error variances for the three subsample regressions (17.97), indicating that considering the samples separately provides a better fit to the data. For this particular example, the Chow test produced an F value of 3.93, which is statistically significant at an alpha of 01.

Considering all possible two-way combinations of the four screening criteria examined in this study, with 13 dependent variables, a total of 78 such Chow tests were conducted. The results of those Chow tests are reported in Table 5. By chance alone, one would expect approximately 3 or 4 of the 78 relationships (approximately 5%) to be statistically significant. Fifty-five of the 78 Chow tests (approximately 70%) resulted in F values that were statistically significant at the .05 level of confidence. The combination of the age and growth subsamples resulted in the fewest significant Chow tests (5). Three combinations, age and innovation, size and innovation, and growth and innovation each resulted in 11 statistically significant Chow tests. This finding strongly indicates that screening criteria selection affects the results of empirical entrepreneurship research. Independent-dependent variable relationships vary widely with screening criteria selection.

Table 6 provides additional detail by showing the regressions of the independent variables on the dependent variables by subsample. Given the need for parsimony, it is not practical to show regression results for every possible combination of two screening criteria. Table 6 does, however, indicate where likely significant differences due to screening criteria exist. For example, Industry Price Wars and Differentiation Strategy were both found to be significantly related to Return on Equity in the size and age subsamples, but not in the growth or innovation subsamples. Table 6 also indicates where mixed messages to researchers and practitioners are likely to emerge. Using the previous example, the reader of an article based on a sample of small or young firms would make a very different conclusion than the reader of an article based on a sample of high-growth or innovative firms.

Collectively, the results presented in Table 6 are very consistent with the results presented in Table 5. Both analyses indicate that the choice of screening criteria significantly influences independent-dependent variable relationships. The Chow tests presented in Table 5 provide an empirical test of the general hypothesis that screening criteria selection affect independent-dependent variable relationships while the results presented in Table 6 provide details as to specific relationships that are altered as a result.

Discussion

Improving methods in entrepreneurship remains an important issue. This article demonstrates that using different screening criteria can significantly affect the results of our research. The methodology used in this paper was decidedly conservative. Each of the subsamples used in this study came from the same larger sample and the methods of data gathering, coding, and variable construction were consistent across the different subsamples, a situation unlikely to exist when comparing the results of different authors. Moreover, the fact that some of the firms appeared in multiple subsamples should have had the effect of reducing the likelihood of noting significant differences. As a result of these similarities this study probably understates the impact of screening criteria selection. Assessing the effects of screening criterion selection when such restrictions are removed may provide an

Table 5. Chow Test Results (F values)

	DTA	*DTE*	*Liquid*	*STA*	*STE*	*ROE*	*ROA*	*ROS*	*NI*	*COMP*	*Sprof*	*Sgrow*	*Sprod*
Age and Size	*2.42	1.09	1.92	*2.38	**4.28	**4.45	**3.67	**3.42	***12.13	***17.50	***5.66	***6.38	.91
Age and Growth	.94	1.73	1.46	*3.11	1.6	**4.32	*3.08	1.27	***8.55	***13.70	2.30	1.84	1.28
Age and Innov	**3.55	**3.72	*3.01	**4.72	*2.94	**3.63	2.08	1.34	**3.37	***5.33	**3.52	**4.22	*2.98
Size and Grow	1.40	.45	1.71	2.25	***5.21	**3.68	**4.49	*2.95	***22.31	***31.20	2.17	***6.15	1.77
Size and Innov	**3.84	*2.50	*2.49	*2.79	***4.81	*3.24	*2.54	*3.11	***15.05	***22.90	1.03	**3.71	1.85
Grow and Innov	**3.93	*3.15	**3.59	1.70	*3.22	2.08	*3.21	*2.52	***5.27	***7.65	*2.64	***4.94	*2.52

ψ = p<.10, * = p<.05, ** = p<.01, *** = p<.001

Table 6. Regression of Independent Variables on Dependent Variables by Subsamples

	DTA	*DTE*	*Liquid*	*STA*	*STE*	*ROE*	*ROA*	*ROS*	*NI*	*COMP*	*Sprof*	*Sgrow*	*Sprod*
150 Smallest Firms													
Industry Price Wars	-.01	-.06	.18	.06	-.18	*.23	.17	.14	-.05	-.14	.07	.11	.02
Differentiation Strategy	.06	.10	-.02	*-.18	-.14	*-.20	-.14	.06	-.11	**-.23	-.07	-.07	*-.21
Low-Cost Strategy	.03	-.01	-.07	-.01	.09	-.02	-.12	-.16	-.06	.16	-.13	-.14	-.12
Initial Planning	**.25	*.20	-.12	.04	.04	-.01	-.13	-.13	-.05	.07	-.12	-.15	-.13
Commitment	.01	.01	-.09	-.17	.05	-.09	-.03	.03	.02	.14	***.33	***.30	*.18
F	1.63	1.36	1.36	1.23	1.60	*2.34	*2.38	1.92	.55	**3.40	***5.87	***6.12	**4.15
Adjusted R Square	.03	.02	.02	.01	.02	.05	.05	.03	.00	.08	.14	.15	.10
150 Youngest Firms													
Industry Price Wars	-.03	-.09	.10	.12	-.04	**.24	.17	.17	.01	-.15	-.08	-.04	.06
Differentiation Strategy	.05	.06	-.01	-.17	-.11	*-.20	-.13	-.03	.01	*-.19	-.08	*-.17	***-.27
Low-Cost Strategy	-.06	-.07	-.01	-.06	**.24	.04	-.13	-.09	*.18	***.29	.02	-.02	-.06
Initial Planning	***.35	***.41	**-.27	-.03	-.01	**-.26	*-.19	-.17	-.03	-.04	*-.16	-.02	-.13
Commitment	-.02	.02	-.04	-.11	-.07	-.07	-.01	.01	.07	.10	***.40	***.38	*.17
F	**3.27	***4.98	2.17	1.22	1.84	***4.53	*2.96	1.92	.89	***4.28	***6.70	***6.85	***5.00
Adjusted R Square	.09	.15	.05	.01	.03	.12	.07	.04	.00	.11	.16	.16	.12
150 Growth Firms													
Industry Price Wars	-.09	-.11	.14	-.06	-.12	.13	-.01	.05	.01	-.12	.12	-.04	.03
Differentiation Strategy	.08	.13	.04	.01	.01	-.12	.04	.02	.02	-.01	-.02	*-.16	***-.32
Low-Cost Strategy	.09	.03	-.06	-.04	***.36	-.02	-.12	-.15	**.26	.17	-.09	-.09	-.12
Initial Planning	***.39	***.34	**-.29	-.02	.02	-.07	*-.19	-.15	-.11	-.09	-.11	-.06	-.03
Commitment	-.02	.01	.02	.04	-.01	-.01	.07	.06	*.17	.18	***.31	***.39	**.22
F	***4.79	**3.87	*2.75	.18	**3.82	.91	1.54	1.52	*2.76	1.77	***4.51	***7.75	***6.90
Adjusted R Square	.15	.12	.08	.00	.10	.00	.02	.02	.06	.03	.11	.19	.17
150 Innovative Firms													
Industry Price Wars	-.03	.01	.09	-.01	*-.21	.11	*.18	*.21	-.08	***-.28	.06	.03	-.08
Differentiation Strategy	-.02	.06	.08	-.12	-.13	-.11	-.10	.01	.01	-.11	-.13	*-.16	***-.32
Low-Cost Strategy	-.02	-.05	.01	-.01	***.29	.01	-.15	*-.17	**.26	**.25	-.04	-.10	-.06
Initial Planning	**.27	**.27	**-.26	-.04	**-.21	**-.22	*-.18	-.16	-.06	-.07	-.13	-.14	-.11
Commitment	-.14	-.14	.02	-.03	.05	.09	.08	.09	.14	*.17	**.25	***.31	*.18
F	2.13	*2.30	2.01	.41	***4.44	*2.33	*3.08	*3.01	*2.70	***5.44	**3.94	***6.41	***6.87
Adjusted R Square	.05	.05	.04	.00	.11	.05	.07	.07	.06	.14	.09	.15	.16

Standardized Regression Coefficients Reported
* = p<.05, ** = p<.01, *** = p<.001

opportunity for future research.

Previous authors have found differences between firms or individuals at opposite ends of the same criterion; for example, finding that growth-oriented firms are different than non-growth-oriented firms. Less attention, however, has been paid to differences between screening criteria. This study directly addresses that issue by examining the effects of selecting samples based on age, size, growth, and innovation. A limited number of frequently used screening criteria were examined in this study. However, many different screening criteria are in use by entrepreneurship researchers (Vanderwerf and Brush 1989: Murphy 1996). Future research may benefit by considering other screening criteria.

The finding that screening criteria selection can influence independent-dependent variable relationships is significant. Authors are probably less likely to specify the screening criterion used when the criterion itself is not a major focus of the paper. The result, as demonstrated in this study, is that seemingly parallel studies addressing the same issue can produce confusing results as a result of differences in screening criteria. Confusing results may, in turn, slow the rate of theory development in the field.

The implications to practitioners are also significant to the extent that they depend on clear interpretation and application of research findings. Prescriptions offered to practitioners by consultants may be less valid or even invalid if the characteristics of the study sample do not closely correspond to the characteristics of the client firm.

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